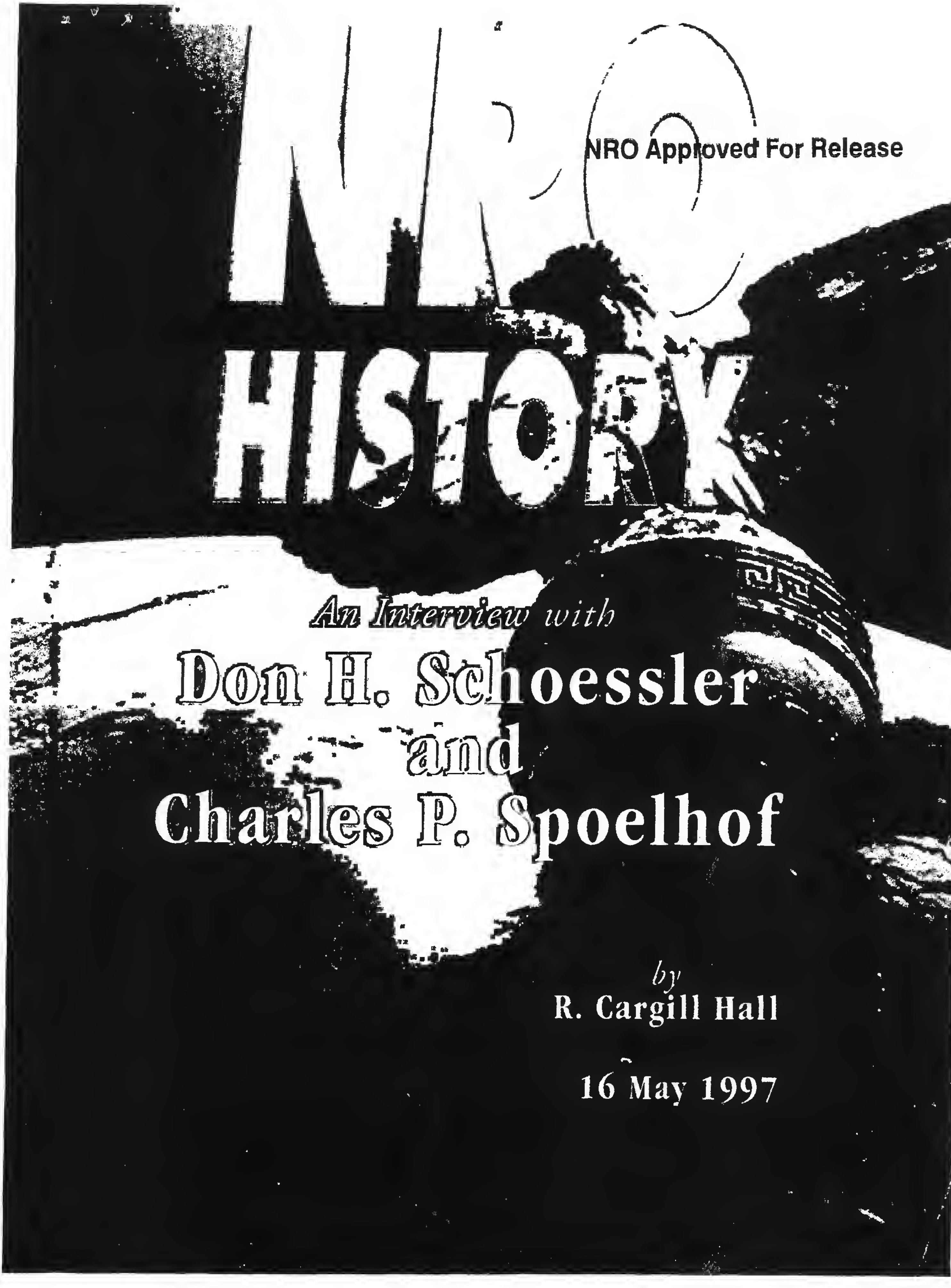

HISTORY

An Interview with Don H. Schoessler and Charles P. Spoelhof

by
R. Cargill Hall

16 May 1997

NATIONAL RECONNAISSANCE OFFICE

ORAL HISTORY PROGRAM

AN INTERVIEW WITH

CHARLES P. SPOELHOF and DON H. SCHOESSLER

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National Air And Space Museum

Washington, D.C

PREFACE

In the 1950s, pressing intelligence demands of the Cold War promoted the employment of various aerial and satellite reconnaissance systems. The reconnaissance imaging systems used special film, and the Eastman Kodak Company in Rochester, New York, produced almost all of it. On 16 May 1997, following a special CORONA Program symposium held at the Smithsonian Institution honoring Amrom Katz, two retired EKC executives who had played a major role in the development of this film agreed to an oral history interview. During the interview, Charles Spoelhof and Don Schoessler discussed the historical development of films used in aerial and space reconnaissance, with special emphasis on the CORONA Program. They also considered EKC research practices, the film base, its manufacture, sensitivity, stability, latitude, pelloid component, spooling, and methods of image motion compensation. Their recollections contribute significantly to an understanding of film-based imaging. I commend this interview to anyone interested in the subject.

This interview is UNCLASSIFIED.

R. Cargill Hall 2 March 1999

PROCEEDINGS

CARGILL HALL: This is an oral history interview with two former Eastman Kodak Company executives, Mr. Charles Spoelhof and Mr. Don Schoessler. The date is 16 May1997. The place is the National Air and Space Museum.

I think we might begin, gentlemen, if each of you would tell me briefly where you were born and raised, and how you came to Eastman Kodak, and then we'll go on from there. Charles, would you like to begin?

CHARLES SPOELHOF: Yes, I came to Eastman Kodak after finishing some graduate studies at the University of Michigan and was interested in photography and in space. Obviously I was going to the right place for photography, but I knew nothing about what would happen later on. After working in some commercial and also some government programs back in 1954 when I first joined the company, about a year or so later I started on the WS-117L program, and was quite thrilled to get in on that.

My responsibility was for the camera of that system and one thing led to another as we got involved in many things at Kodak and of course with other associates in the industrial field dealing with many of these space systems for reconnaissance and exploration.

Is that enough background, Cargill?

H: Yes.

DON SCHOESSLER: I'm Don Schoessler, and I joined Eastman Kodak in 1947 initially. I was going to the School of Mines at Rapid City, South Dakota, and was taking advantage of the G.I. Bill of Rights.

I had no idea what happened in industry. Coming from South Dakota there is very little exposure to industry. A fellow student and I came to work for the Eastman Kodak Company for 12 weeks during the summer months, for both my last two years at school. Upon graduation, I was very much interested in Eastman Kodak Company as a result of my previous experience. I wrote one letter of application and was accepted.

I was assigned to work initially in the Kodacolor Production Department. Kodacolor was a brand new product with less than one percent of all the photography being made in color at that time. I was assigned to be a shift foreman in that same department that I had previously worked in during the summer months.

In 1955, I was transferred to Palo Alto, California, establishing the Kodacolor process, in California. About the same time, the government was interested in Kodak decreasing its Kodacolor business. A court decree was issued requiring Kodak to give up more than 50 percent of the Kodacolor business. That meant that Kodacolor was probably no longer an attractive growing industry for Kodak. I chose to stay with Eastman Kodak Company and sought reassignment.

That led me into space technology, working with the Research and Engineering Department of Eastman Kodak Company back in Rochester, New York.

H: What was the date that you formally joined EKC?

SCHOESSLER: I joined Eastman Kodak on a full-time basis in June of 1949. I worked with Kodacolor until May of 1958. I became involved with Kodak's support to government operations in May of 1958.

H: So the film used in the Eastman Kodak cameras for WS-117L obviously was Eastman Kodak film and it also was used in the CORONA project. It originally was the acetate-based films?

SPOELHOF: The film used originally was manufactured on acetate base. Aerial photography during World War II and the Korean War used a high-speed, fairly low resolution acetate base film. This film worked well in the vibrating airplane systems that existed at that time. So when we got into space reconnaissance, starting with WS-117L, the environment was going to be pristine from the standpoint of stability, but the photographed objects were so far away. It was necessary to work out a means of getting much higher resolution. Therefore, slow, fine-grained films looked like the way to go.

The only experience Kodak had in it at that time, if I remember it correctly, was really in the commercial field. These were microfilm-type emulsions and things that fit into that category exposed on the ground under controlled conditions. What Kodak had to do was to extrapolate. It had to manufacture a finer grain film incorporating all the features required of an aerial film. An aerial film is very different than the film that you use, for example, in a regular camera.

Do you want me to go into that at all, Cargill?

H: I think that that would be important to know.

SCHOESSLER: The sensitivity is entirely different.

SPOELHOF: For example, just to use a comparison, the film that you put in your camera

for everyday photography tends to have fairly high speed, because it must accommodate a wide range of light conditions. And in addition to that, it must have long latitude. That is, you can expose it either to very bright things or very dim things.

That type of film would be quite useless, if used in aerial photography. In aerial photography, you're trying to penetrate through a haze, which is the natural haze of the atmosphere. The range of exposure is relatively small at any one time. You want to use a very high contrast film under those circumstances. However, a high contrast film, by definition, will have a small latitude range. Thus, the exposure control is very critical, as is the photographic processing of aerial exposed images. That's one aspect.

Another aspect is that as you're trying to penetrate the haze of the atmosphere, you can do this better with the longer wavelengths of light, that is the red, even into the infrared, is far better than using shorter wavelengths. We typically added filters over lenses that would block out the blue end of the spectrum and sometimes even a portion of the green end of the spectrum.

So, a film with entirely different sensitivity, a different emulsion, and higher resolution was developed for the WS-117 program.

SCHOESSLER: These films were at that time all coated on acetate support and in most cases the acetate support that was available at that time was about 5.2 millimeters in. . .

SPOELHOF: Mils, or thousandths of an inch.

SCHOESSLER: Excuse me, mils in thickness.

H: Now, when you came to Project CORONA, the company began to provide film in this same general range?

SPOELHOF: Yes. By that time it had. Aerial films, not the final version that was used in CORONA, but aerial films of the right sensitivity and speed and high resolution had been achieved. But they were not ideal for a CORONA system, which placed physical demands on the film that were much in excess of what other systems like WS-117L required.

Don, you can comment on that better than I.

SCHOESSLER: Right. With the 117L, we had a controlled atmosphere because we developed the film in space with a moist chemically impregnated film called Bimat. That process needed an atmosphere to maintain a proper humidity range.

The CORONA program operated in vacuum. As a result of these vacuum dry conditions, the solvents in the acetate support would out-gas, leaving the support base very brittle and

subject to shattering under load. Initial vacuum chamber tests in the CORONA program with the acetate film were very catastrophic; it just didn't work.

About the same time, Dupont was producing a product called Mylar. Eastman Kodak investigations indicated that this would probably be a very ideal support for photographic films in the vacuum of space. Eastman Kodak Company made licensing arrangements with Dupont to be able to manufacture polyester terathalate. Kodak called this Mylar photographic film support "Estar." The Eastman Kodak Company was limited to make Estar only for photographic use.

The initial thickness of Kodak's Estar film was 4 mils. The first coatings on Estar were 4 mils thick, containing an emulsion coating on one side, incorporated all the characteristics required for aerial photography. There was also a very thin additional coating applied to the backside of the film which was called pelloid. The pelloid is necessary to maintain flatness in the film; without the pelloid coating the film will curl. Control of film curl is particularly important when the film is immersed in the liquid photographic process and during the subsequent drying phase. The pelloid also contains extremely small, fine bead particles made of glass. These beads prevent the film from sticking to each other, particularly if the humidity conditions are not exactly correct.

SPOELHOF: Let me add to that a little bit. The pelloid also gives the proper physical characteristics for friction so it can be handled quite well in cameras. So one's working not only on the emulsion properties and getting a base which is adequately strong, but also looking at the frictional and handling characteristics of the film in order to achieve what is necessary for space.

SCHOESSLER: And in addition to this, the pelloid also serves another function in that it avoids the scattering of light once the light has penetrated the emulsion so that it provides an antihalation protection so that you don't get a bounce-back exposure.

H: The first tests and the first flights took place in '59. By 1960 acetate shattering had become a major showstopper. Apparently the whole program had reached a point where Richard Bissell and others were not certain they could solve this problem. So it was this research and the decision for Mylar that really saved the program?

SCHOESSLER: The Estar film solved the shattering problem. And without the Estar film, there was no way that the acetate films could have or would have functioned correctly, particularly in the intricate film path system of the CORONA program.

H: Which, as you say, was one of the most intricate of any.

SCHOESSLER: It was the most intricate, complex, film path system that I have experienced.

H: In the space program?

SCHOESSLER: Well, in any program, because the film must have the same speed at the supply end and at the take-up end of the system. But in between it is twisting, stopping, accelerating, and decelerating. It's moving in different directions and velocities so that the film gets a severe workout. And it's amazing that the designers of the camera system were able to achieve success in handling the film adequately under these very diverse conditions.

H: About what period of time are we talking about that the investigations went on and the solution arrived at Eastman?

SCHOESSLER: Mid-'59 to '60 because the first 12 launches of the CORONA resulted ultimately in failure, as we've all heard. But every CORONA camera system that was launched with film on board was launched with Estar film.

SPOELHOF: But the Estar, of course, was something Kodak was digging into before it got to the CORONA program. I think that's correct is it not?

SCHOESSLER: I think that is correct, yes.

SPOELHOF: The use of Estar film for CORONA was an excellent solution with something that was already being looked into for special applications and for other commercial needs where you need a special strong and stable base.

H: All right. So in essence, the problem was recognized before it ever got into space.

SCHOESSLER: Yes.

SPOELHOF: Oh, yes. Why don't you comment, Don, about the steel-based film.

SCHOESSLER: Well, at one of the interface meetings, probably one of the first meetings that I attended as the interface person for Kodak, one of the gentlemen in the crowd asked, "Is it possible to coat emulsion on thin stainless steel to get the strength that we need?"

I indicated yes, it's probably possible to do that. But how will we make a copy of that original. . .

SPOELHOF: Because we can't see through steel!

SCHOESSLER: So that was the end of that discussion.

H: That's a good story. Well, now, with the film you'd gone from 5 microns to 4 microns.

SPOELHOF: No, from 5 thousandths of an inch. Mils are thousandths of an inch here.

H: I'm sorry, mils.

SCHOESSLER: The acetate was 5.2 thousandths of an inch or 5.2 mils. Estar was initially extruded to a dimension of 4 mils. And then, with the relentless need for more reconnaissance film to be packaged for less weight, it became essential to do a number of things in the film domain. One, is it possible to make strong film thinner. Two, is it possible to coat longer lengths of film because filmmaking is done in batches with a finite length. Splicing of the Estar support is a feat in itself because the Estar film in its splicing operation has to be very significantly thicker than the film itself. The problem of splicing the Estar film was solved through an ultrasonic splicing technique. And, of course, any time that you splice a film you tend to weaken it at that spot, so that the splices had to be strong, they had to be reliable, and from a systems point of view, as few as possible.

As a result of these considerations, it was then necessary to coat the Estar in lengths as long as possible and also to make as few splices as possible.

SPOELHOF: Do you remember what those lengths were, Don?

SCHOESSLER: The lengths we were trying to achieve were 6,000 feet of film in a continuous length without a splice. Then, as we went into the CORONA prime programs, and the J program, we had two rolls and two buckets.

As the demand for more film load increased it became necessary to splice 6,000-foot lengths together to ultimately achieve I think something like 16 or 18,000 feet in a continuous roll. That generated another concern. The production of Estar is not like coating a solvent mixture over a drum and extracting the solvents to form a uniform coated support.

Estar is initially a viscous material that is extruded out of a. . .

SPOELHOF: Hopper?

SCHOESSLER: Well, it isn't a hopper. It's out of a precision dye, literally. And the dye opening is approximately 12 inches wide and approaching maybe a quarter-inch in thickness. As the Estar is extruded out of this dye, it goes through a process called tentering. Tentering means that the sides of the extruded material are grasped at its edges and it is pulled laterally and longitudinally simultaneously by a dimension in excess of four times its original width and length.

This is done under heat lamps and under very controlled conditions. With a process such as this, it's also absolutely necessary to extrude a material that is extremely flat or uniform in thickness from side to side and from length to length.

H: That would be a major accomplishment, to be able to get that kind of uniformity in the lengths you mention.

SCHOESSLER: That is correct. And so "hard streaks" became one of the things that we would have to inspect for. Of course, this can be done when you have the 6,000-foot lengths of film support that has not been emulsion-coated.

Why, you can take a section across the entire width of your whole master roll and then run a micron trace over that to see whether you have "hard streaks" in it. And because we are only looking for 70-millimeter segments to come out of the master rolls that were in excess of four feet in width, it was possible by quality inspection to isolate the areas of the master roll that would produce the optimum film for the CORONA program.

SPOELHOF: So for every time you turned out 6,000 feet of film, you didn't get the full amount—that is, there was a portion of reject material, in order to achieve the tolerances that were necessary.

SCHOESSLER: I brought along a piece of high-tech technology here. It's a roll of toilet paper, but this roll of toilet paper has a streak in it to give you the visual effect of what a hard streak in a roll of Estar might produce.

SPOELHOF: "Exhibit 1."

H: I'll certainly keep that in mind when I'm next confronted with a lumpy roll—but that is a very good analog, for a person to see this visually.

SCHOESSLER: A "hard streak" in a single thickness doesn't create much of a problem. But, when you wrap it on itself to obtain three miles or maybe five miles of film and it's in the same spot, the cumulative addition of that minor amount of anomalous thickness becomes tremendous.

SPOELHOF: This may sound like a minor addition, but one also has to worry about sending this film into space in such a way that the rolls do not in any way slide or telescope. As I remember the CORONA system, it is launched in a direction parallel to the rotational axis of the film, so the film could easily slide if a flange didn't carefully hold it.

SCHOESSLER: That is correct. The CORONA program used flanges on both sides of the supply roll to alleviate this problem.

SPOELHOF: So it would go through the high acceleration portion without telescoping.

H: So then the flange would move back after. . .

SCHOESSLER: No, no. The film was spooled. The actual mechanism for producing a CORONA roll consisted of taking the machined titanium core [film spool], removing both flanges from the core and mounting it to the spoolers in the spooling operation.

In order to gain uniformity of the film roll as it is spooled, a roller that was called "the builder roller" is in contact with the roll to maintain compression. The builder roller also has a small flange on either end to maintain accurate winding so that the film lines on itself without any lateral movement. The builder roller also applies a slight amount of pressure to provide a small amount of tension into the entire roll as it gains diameter.

After the film is spooled to the desired diameter, the core with the film is removed from the spooling machine and the flanges are re-applied to the core. The titanium core with the wound film between the two flanges provides the film load for the CORONA program. Now, of course, all of this is done in complete darkness because we don't want pre-exposed film to go into space.

H: The early systems CORONA had one bucket, one take-up reel, and about what, 6,000 feet to start with?

SCHOESSLER: The original roll I think was only 2 or 3,000 feet in length. I think the original roll was 3,000 feet in length and I think 2,000 got exposed and returned with the first flight. I may be off on those numbers but that is my recollection. Then as the program developed and gained maturity and additional booster capacity was available, it was always the push to get more and more film into each load to maximize the utility of the system.

H: Because the whole mission was. . .

SCHOESSLER: To bring back film. It was everyone's objective; everyone's efforts were focused to bring back photographs from space.

SPOELHOF: And the more the better.

SCHOESSLER: The more the better, and so that made my interface responsibilities very interesting because everybody wanted to use more and more of the product that I was representing.

H: And so, eventually at the end of the program, with the two buckets and the additional cameras you were running out at—how many thousand feet?

SCHOESSLER: And then there were two rolls. And I don't recall the numbers, but I'm trying to see if I can't quickly research this with some literature that we have.

H: And meanwhile—as you say, EKC had gone from 5-mil acetate to. . .

SPOELHOF: Down to 2.5. mil Estar.

H: It decreased in thickness even furthe r?

SPOELHOF: Yes.

SCHOESSLER: It went to 2.5 mils.

SPOELHOF: From 5.2 to 4 to 2.5.

H: And it could still run through that camera and take-up system and take those stresses?

SPOELHOF: Yes.

H: But at 2.5 mils you're talking Saran Wrap, almost.

SCHOESSLER: It's frequently been called that, too. That's a very good analogy, because essentially that's what it was. Now, the company has produced even thinner films, down to 1.5-mil material, 1.5-mil Estar. And some of these films at that dimension were tried in the CORONA program. But that film was so thin and pliable that it did not have enough structural beam strength to stay within the guiding rails of the arc platen of the CORONA program. It would pull out of the platen and rails.

In summary, there were two rolls, each 16,000 feet in length, made up of 2-1/2 mils of Estar support coated with about a half a mil of both emulsion and pelloid so that the entire thickness of the film package was approximately 3 mils thick.

H: And it was spliced about every 6,000, roughly.

SCHOESSLER: Yes, every 6,000 feet we had a splice. We also found that we were able to gain additional tensile strength at the splice by taking a half-moon notch out of each side of the splice to form a notch cutout. This provided two things. One, it enhanced the tension, but also in case a sprew [extreme of the edge] developed as a result of the ultrasonic pounding of the two pieces of Estar together, the notch would remove the sprew.

SPOELHOF: Well, just a word on the ultrasonic splice. In a sense it's like peening the film, if you want to call it that, so that it welds together.

SCHOESSLER: That is correct.

H: As if you took a hammer, the peen or ball of the hammer.

SCHOESSLER: Yes, right.

H: Looking back at this, what, to your view, were the principal technical achievements, among those that we have just discussed? Were there any others that factored into this?

SPOELHOF: Let me start with this one. I think the start is to get the fine grain emulsion of high enough speed and all the proper characteristics to work this way in aerial photography. And maybe I can add a little bit to that later, but let's make the list first. That certainly was an achievement in itself because that was not previously available. Aerial film was much coarser grained, but also higher speed.

SCHOESSLER: And that evolved in two iterations, because the original speed of the films used in the aerial flights was quite a bit faster than the finer grain films that ultimately evolved to be used in the CORONA system.

Probably, from my perspective, looking at the film manufacturing part of it, a major advance was the ability to produce flat films. Because that was—once you understand the technology in extruding film base, it became absolutely vital to have flat film. It had to be spooled on itself, many wraps to obtain the exceedingly long lengths. Any small variation in thickness compounds with each wrap and results in an undesired increase in roll diameter. Glass plates coated with photographic emulsion, used for the most precise scientific applications have dimensional tolerance of a half micron. Ultimately, the technology of extruding Estar was able to match that thickness tolerance.

SPOELHOF: Just so we don't confuse these two terms here, micron being micrometer, and the mil that is a thousandth of an inch. And a micron obviously is about 25 times smaller than a thousandth of an inch.

SCHOESSLER: So this is almost super flat support that was needed and it was produced in order to make possible these long lengths that would have the right tension characteristics to meet the needs of the CORONA project.

H: And uniformity of thickness?

SCHOESSLER: Uniformity of thickness to achieve the requirements of the mission.

H: Another outlook?

SPOELHOF: Let me talk for a moment again about emulsion. How much time do we have? Enough?

H: Yes, we have another five minutes.

SPOELHOF: Let me hop back in fact to something that Amrom Katz had said in his development work during the '40s when they were experimenting with all kinds of camera systems and films and so forth from aircraft at Wright Field. Amrom was very good at laying down some rules of thumb. One of them was: "There is no substitute for focal length." In other words, the larger the scale image you could get, the better off you were.

Now, going into space, obviously you're going to be 10 or more times higher in altitude than an aircraft. And therefore the scale has to be small. And the small satellites that were sent up originally did not have the capacity to handle huge focal lengths. So we were dealing with something that had to be very high in resolution.

The achievement of 100- to 200-lines per millimeter was really, I think, the major thrust in the whole space reconnaissance program. And we got there not in one jump, but in a gradual way of exchanging better lenses, better attitude control—because motion is extremely important as well—better emulsions and better processing. We haven't talked about processing yet, but the chemistry that's used in bringing out the image is just as important as making the film.

Now a little bit about this balance and Amrom Katz's rule there is no substitute for focal length. It turns out that as you're putting lenses into space, one of the limitations is the size of the lens aperture you can put up there. And the aperture is limited more by the amount of weight that you can carry than anything else. Just to use the Hubble space telescope as an example, there is a 94-inch aperture.

Obviously, that was not what was done in these early days. Then we were dealing with a few inches of aperture. But the bigger the aperture, the better off you were from the standpoint of collecting more light. The more light you could collect for the same focal length, the finer an image you would produce because of diffraction as long as you designed the lens to be diffraction-limited. So we were dealing with lower and lower f-number lenses that had the combination of higher lens speed as well as higher potential resolution.

And when one balances these things out, looking at the combination of what you can afford in weight and size to put in space, and balance this against the quality of the lens, the quality of the film and the speed of the film and the quality of attitude control and of image-motion compensation, you come to a very fine balance and you find that too long a focal length is bad and too short a focal length is bad.

You pass through an optimum, in other words. And this optimum is what we gradually put together in our systems, both by experiment and by theory. And so, I remember telling Amrom Katz, "I've got a new variation on your rule. There is no substitute for aperture." And of course that's very similar to what the astronomers have known all along. That's why they build bigger and bigger aperture telescopes.

And basically, that's what we faced and how it was resolved. Now, there was a great deal of science that went into the whole system of how do you balance out these things. To give you a little background in Kodak's work, Kodak in its research labs did a rather elaborate study of looking at a variety of films, a variety of lenses, a variety of image motion, and so forth, to find out experimentally what that balance would be.

We did it simultaneously using some theory and gradually honed the theory to match the experimental results. And out of that work came a guidcline to use for future space reconnaissance systems.

Lockheed was just as important a contributor to all this because you had to know exactly what height you were above the Earth to get the image motion compensation correct, and you had to have three-axis stability, which had to be ideal. And as time went on, the firm found ways to continue to improve spacecraft three-axis stability.

SCHOESSLER: We've talked about the dimensions of the film. The initial film loaded into the CORONA system was identified as SO-243, the "4" indicating the mil-thickness of the product. Later, that changed to SO-132, the 3-mil film with the thickness. My memory is a little bit hazy, but through the life of the CORONA Program there was also an emulsion breakthrough. Kodak was able to produce a finer-grain film emulsion for aerial space applications, which provided higher definition photography without sacrificing loss of film speed.

H: Was the speed given in ASA numbers?

SCHOESSLER: There were equivalents, but we didn't use them as. . .

SPOELHOF: ASA?

SCHOESSLER: ASA numbers.

SPOELHOF: You need a different measuring system, because you're dealing with a very different type of photography. As mentioned earlier, it is the high-contrast type of photography versus the long latitude photography.

SCHOESSLER: We got more resolution for less light after the emulsion breakthrough had occurred. Because I remember prior to this asking Dr. Learmakers in our research labs whether he could see any future development in black and white photography that would change the speed-to-resolution balance. And at that time, he indicated no. But then a couple of years after that, the research labs were able to achieve a rather incremental improvement and that, in turn, further aided the capability of getting higher resolution for the same amount of light.

SPOELHOF: Let me add now the chemistry at the end. And as I mentioned earlier, this is extremely important, essentially as important as designing the emulsion correctly and making the film correctly.

One strives to process the film in such a way that it retains a maximum resolution and still maintain a maximum speed. One can over-process to hurt the resolution by making the film grainy, or one can under-process and not get the right tonal characteristics. So a great deal of work was done in terms of what chemistry should be used in order to develop these films. Anything on "interrupted processing," Don?

SCHOESSLER: I don't know whether that information has been shared or not, but. . .

SPOELHOF: Okay.

H: Well, you use your judgment. All the developing was done at Eastman Kodak?

SPOELHOF: We did the—let me put it this way.

SCHOESSLER: We did the development work for it.

SPOELHOF: Yes, we developed the emulsions and the chemistry in order to do this. The government then. . .

SCHOESSLER: Dictated where the film development would take place.

SPOELHOF: Yes, where the processing and duplication would be done.

H: Well, I don't know if that's been declassified now or not.

SPOELHOF: It hasn't.

H: It hasn't? Then we won't get into that. I thank you both very much. I appreciate your time and I'll try to get a transcript to you.

[SPOELHOF: Since this interview it has been revealed that Kodak also did the processing and duplicating of mission film.]

SPOELHOF: May I add one thing?

H: Oh, yes.

SPOELHOF: And that is—I said this earlier in the conference and I'm not sure I said it in an appropriate way, but let me put it this way. Kodak is very jealous, if I can put it that way, of its technology. And as a result of that, Kodak did have this rule that anything that it would develop with new technology that could be applied to this reconnaissance effort would be something Kodak would pay for itself, with corporate funds. So the government did not buy the R&D. It did buy, of course, the film and the materials, processing equipment, and such things as that. But Kodak did the R&D with its own research and development funds.

SCHOESSLER: Corporate sponsorship, yes.

H: So if there were a request for some new techniques, you would pursue it?

SCHOESSLER: This fell directly into my domain. I was the interface liaison person representing Kodak at the interface meeting. I don't know of a single event or a single government request that was made of the Eastman Kodak Corporation that wasn't implemented or acted on by the company. If it involved expending development dollars on the part of the Eastman Kodak Company, they were spent. All film modifications or improvements were made with Kodak finish. The film that was used for CORONA, or any other government-sponsored project, involved an "over-the-counter" purchase.

H: One last question. You had mentioned the emulsion breakthrough?

SPOELHOF: Uh-huh.

H: To what, specifically, do you refer when you say the emulsion breakthrough?

SCHOESSLER: Kodak was able to precipitate silver halide in a different manner that provided greater efficiency of that halide to retain or to accept an exposure.

H: And it was another one of these achievements that came with these other things going on.

SCHOESSLER: Yes, right.

H: It was an extremely fertile period at Kodak.

SPOELHOF: Now, you could either get higher speed for the same granularity or quality and resolution, or you could get higher resolution with finer grain for the same speed. In other words, it was a step forward. And those are technological breakthroughs, which were extremely important.

SCHOESSLER: Because normally there's a tradeoff. If you gain in one, you lose in the other. And this was a win-win situation that we got more out for the same amount put in.

H: That's remarkable. And all this took place within a few years.

SPOELHOF: Yes.

H: It must have been a very exciting, very fertile period.

SPOELHOF: Oh, extremely. Very exciting. I mean, there were new things coming down all the time and you had to really stay in touch with the new developments because they affected whatever work you were doing.

SCHOESSLER: And in this period, as I've told my family, I had two careers, one with the family and one at work. But you never mixed the two because of the security restrictions.

H: Again, my thanks to you both. I appreciate it, and I'll send you a copy of the transcript.

SCHOESSLER: Good, okay.

SPOELHOF: Take care.

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